Aging Aircraft Structural Integrity Research

In response to public concerns after the Aloha Accident, Congress passed legislation known as the Aviation Safety Research Act of 1988.

As a result of the Act and concerns relating to the increasing age of the air carrier fleet, the FAA developed the National Aging Aircraft Research Program (NAARP) to ensure the structural integrity of high-time, high-cycle aircraft. The NAARP structural integrity program area includes three major elements: methodologies to predict the onset of widespread fatigue damage (crack initiation, crack growth, and residual strength), supplemental structural inspections for commuter aircraft, and airframe repair assessment.

Methodologies to Predict the Onset of Widespread Fatigue Damage. Widespread fatigue damage (WFD) in a structure is characterized by the simultaneous presence of cracks at multiple structural components where the cracks are of sufficient size and density that the structure will no longer meet its damage tolerance requirement. To ensure that the residual strength of an aging aircraft is not degraded below limit levels due to the occurrence of WFD, predictive methodologies to identify the onset of WFD during the operational life of an airplane have been developed. The methodologies are currently being verified by test data from coupon tests, subscale component tests, full-scale tests, and service experience. The photograph above shows an experimental test fixture that has been designed to test full-scale curved, stiffened panels under pressure and biaxial loading which will be used to validate the predictive methodologies. The test fixture is located at the FAA William J. Hughes Technical Center, Atlantic City International Airport, New Jersey.

A computational tool has also been developed to quantify the risks associated with the uncertainties inherent in the occurrence of WFD. The risk model combines probabilistic techniques and structural analysis capabilities and will be used to do sensitivity studies, aircraft certifications, and evaluations of inspection and maintenance strategies.

Supplemental Structural Inspections for Commuter Aircraft. Increased utilization, longer operational lives, and the high safety demands imposed on currently operating air carrier airplanes have indicated that there is a need for a program to provide for a high level of structural integrity for all airplanes in the commuter transport fleet. Supplemental Inspection Programs (SIP) have been used successfully to provide this level of safety in the large transport segment of the industry.

To extend this concept to commuter category airplanes, the FAA proposes changes to require all airplanes operated under CFR Part 121, all U.S. registered multiengine airplanes operated under Part 129, and all multiengine airplanes used in scheduled operations conducted under Part 135 to undergo inspections after their 14th year in service to ensure their structural integrity. The proposed rule would also require that damage tolerance (DT) based

Safety

SIPs be developed for these airplanes before specific deadlines. This proposal represents a critical step toward compliance with the Aging Aircraft Safety Act of 1991.

It ensures the continuing airworthiness of aging airplanes by applying modern DT analysis and inspection techniques to older airplane structures that were certificated before such techniques were available.

Many commuter airplane manufacturers and operators do not have the large engineering staffs, budgets, or fleet sizes to support a program as extensive as the large transport program. To ease this burden, the FAA is assisting U.S. manufacturers of selected airplane models to develop Supplemental Inspection Documents (SIDs) which could then be used by operators to develop SIPs.

Airframe Repair Assessments. A critical issue identified by the aviation industry (civilian and military) is the need to examine the effects of repairs on the structural integrity of aircraft. The use of damage tolerance methodologies in the maintenance and repair practices of aircraft is required in order to insure their continued airworthiness and operational safety. The resources needed for damage tolerance designs of repairs are lacking for small operators, independent repair facilities, and military repair depots. In an effort to address this need, a task was undertaken under the joint sponsorship of the United States Air Force (USAF) and the Federal Aviation Administration (FAA) to develop a new, user-friendly software tool, Repair

Assessment Procedure and Integrated Design (RAPID), capable of static strength and damage tolerance analyses of fuselage skin repairs. Version 2.0 of RAPID, which can analyze repairs on an aircraft fuselage, has been released; future work will focus on commuter category aircraft.

To find out more about the Aging Aircraft Structural Integrity Program, contact:

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